

NERL Research Abstract

EPA's National Exposure Research Laboratory

GPRA Goal 8 - Sound Science

APM # 643

Significant Research Findings

A Simulation Strategy for Modeling of Nitrogen and Sediment Loadings from the Lower Mississippi River Basin into the Gulf of Mexico

Purpose

A primary environmental focus for the Louisiana/Texas coast is characterization of the role of nutrients and sediments from the Mississippi River Basin on the hypoxia zone ("dead zone") along the inner continental shelf off the Gulf of Mexico. The goal of this research is to characterize the relative importance of sources of nutrients and sediments and their loadings from the sub-basins of the lower Mississippi River basin, and, ultimately, evaluate their impact on water quality in the Gulf of Mexico.

Research Approach

A strategy is presented to develop watershed hydrologic and water quality simulation models of the Mississippi Region. It describes the watershed models that supply input loadings to the Mississippi River and the Gulf of Mexico, as well as water quality models of the interior river basins intended to be used to estimate local impacts of nutrient management activities and practices. The proposed model(s) include watershed hydrologic and water quality components based on the EPA Hydrological Simulation Program - FORTTRAN (HSPF) program; river hydraulic and water quality components also based on HSPF; and lake/impoundment hydraulic and water quality components based on the U.S. Army Corps CE-QUAL-W2 program. Estuarine flow and water quality model components are being developed separately by the U.S. Navy and others as part of efforts to model the mainstem of the Mississippi River and circulation and water quality within the Gulf of Mexico.

The proposed watershed models will be designed to enable researchers and regulators to evaluate the impacts human activities, agricultural practices, land use changes and policies, regulatory actions, and wetland conversion and restoration. This Simulation Strategy for the Mississippi Region is designed as a demonstration of how the proposed models and modeling framework can be used to address these issues not only within the Mississippi Region, but also as a template for possible extension of the approach to other river Basins.

Major Findings and Significance

A pilot program was conducted in the Lower Mississippi Basin to determine whether local water quality problems because of excessive nutrient loading exist, and, if so, to characterize them and determine their relationships to nutrient loading. This demonstration was conducted by the application of the recommended approach (i.e., HSPF/CE-QUAL-W2) for predicting changes in nutrient budgets in response to changes in proposed watershed activities/land use/land cover, resulting in specific recommendations for reducing nutrient load in the Lower Mississippi River Basin. Results indicate that sediment and nutrient loadings to the Gulf are primarily coming from overland flow, and that once in the stream channel, the majority of the nutrients are not degraded before entering the Gulf. Best Management Practices (BMPs) can be used reduce nutrient and sediment loadings in the basin, including precision farming, agricultural nutrient management, other traditional agricultural BMPs, vegetative buffer strips, wetland restoration, and alternate crop buffers. Riparian buffers seem to have a major influence on the hydrology and are a potential sink for nitrogen/sediment. The development of a comprehensive watershed scale riparian model should be a high priority for this research. The land in parts of the Mississippi Basin is extremely flat, making HSPF model simulations inadequate. A more robust hydrology model is needed for these areas.

Research Collaboration and Publications

The simulation strategy was designed and conducted by a research team at the National Exposure Research Laboratory's Ecological Research Division including Robert F. Carousel and Jeff Holland of the U.S. Army Corps of Engineers Waterways Experiment Station.

Carousel, R.F., Holland, J.P. Simulation Strategy for Reducing Nitrogen Loads in Mississippi River Basin. U.S. Environmental Protection Agency. Internal Report. 1999.

Future Research

This strategy has been adopted as the base documentation for the Modeling Subcommittee from the Gulf of Mexico program. It will be expanded over the next two years to include ecological, hypoxic, biological, land reclamation, air, and framework components. At the end of this period the strategy will be developed into a research plan that will be peer reviewed.

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